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FOREST PRODUCTS LABORATORY † FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

SPECIAL METHODS OF SEASONING WOOD

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VAPOR DRYING

Vapor drying is accomplished by exposing wood to the vapors of a boiling organic chemical and removing the mixed chemical and water vapors. The fact that wood can be dried in this way has been known for some time (3,16,18).[1] About 1942 M. S. Hudson, of the Taylor-Colquitt Co., Spartanburg, S.C., succeeded in developing a practical vapor-drying process for railroad ties and poles (2,4,6,11). The process has been patented and used commercially (10). Experimentation has been continued by the Taylor-Colquitt Co. and others. This report has been prepared to give brief information on the basic process. The reader is referred to the Taylor-Colquitt Co. or the cited reports for more detailed information (5,12,13).

The process is conducted in a conventional pressure-treating cylinder. After the cylinder has been purged with steam to drive out air, the wood is heated in the hot vapors of an organic chemical, such as xylene. Heating is continued at approximately 300° F. until as much water has been removed as is desired. The mixed vapors of chemical and water are continuously drawn off and condensed. The condenser is vented to maintain atmospheric pressure. After the xylene and water separate, the water settles by gravity, is metered and discarded, and the chemical is recirculated through a storage tank to the drying chamber. The liquid may be vaporized in an evaporator or in the chamber itself. When most of the drying is done, a final vacuum is drawn. This removes most of the chemical absorbed by the wood during the heating and completes the drying as well. Before preservative treatment is started, residual chemical vapors in the cylinder are driven out by steam.

Oak and gum crossties can be dried from the green condition to 40 percent moisture content in 12 to 16 hours. Average air seasoning times are 12 to 15 months for oak and 8 months for gum. Southern pine poles 8 inches in diameter at midlength can be dried from 90 to 35 percent moisture content in 10 hours. This amount of drying is satisfactory for preservative treatment. Since 1950, commercial vapor drying of oak and gum crossties has increased and the method has been extended to hickory and beech. The process has been one of the major factors involved in doubling the use of hickory for crossties (17). Research has shown that the method is suitable for ties of western softwoods, provided service tests turn out satisfactorily (7).

The accelerated drying is brought about by a drying atmosphere of practically zero percent relative humidity and the high temperature. In addition to speed, vapor drying is claimed to have advantages in reduction of interest charges and handling costs. Another advantage claimed is elimination of seasoning hazards, such as decay. Red oak ties, when vapor dried, develop a great number of very small checks rather than the large seasoning checks and splits common to air-seasoned ties. The small checks are tightly closed on the surface at the end of drying. They can be seen only as narrow, slitlike, honeycomb checks on cross sections. These numerous small checks tend to prevent the concentration of shrinkage stresses at a single weak point.

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[1]Underlined numbers in parentheses refer to Literature Cited at end of this report.

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The Taylor-Colquitt Co. has reported that vapor-dried red oak crossties show losses in compressive strength perpendicular to the grain of approximately 15 percent compared with unseasoned control ties. The cause of this loss has not been determined. The organic chemical vapor excludes air, apparently eliminating oxidation. The water in the drying atmosphere and the outer zones of the wood is so small, and the heating time is so short, that hydrolysis should not be great. Some strength loss apparently is due to the numerous small checks. Less reduction in strength occurs when the wood is dried by short cycles of alternate heating and vacuum, but when these ties are exposed to the weather in service tests, they develop large checks similar to those of air-seasoned ties. Large checks can eventually result in splitting and short service life; so better service is expected from ties dried by the straight cycle.

Vapor-dried red oak and gum ties have been in a test track for 17 years. Photographs show no unusual plate cutting or other damage. From the standpoint of checking and splitting, the vapor-dried ties are in much better condition than air-dried controls.

Vapor-dried and creosoted pine poles were stronger than matched steam-conditioned and creosoted poles in a bending test. Southern pine poles surface-check during vapor drying, but vapor-dried poles contain fewer large checks than air-seasoned poles. Vapor-dried poles weigh considerably less than poles given the usual steam-and-vacuum conditioning treatment, and thus save freight costs.

The use of vapor drying for lumber has been limited. Thick green southern pine has been vapor dried prior to treatment with a water-borne preservative, again vapor dried, then steamed to relieve drying stresses (14). Small green boxed-heart southern pine timbers in which the pith is centrally located have been dried without severe checking. The process has been used for solvent recovery after previously air- or kiln-dried lumber has been treated with an oil-soluble preservative (1,15). It also has been used for final drying and gum removal from previously air-dried cativo lumber.

Research has shown possibilities for successful vapor drying of 1-inch Douglas-fir, pine, and hemlock (8,9). Encased knots in common grades of lumber are loosened. At lower temperatures, achieved under reduced pressures, 1-inch redwood, madrone, and tanoak are dried with only minor defects. California black oak collapsed and honeycombed at 210° F. So far, the vapor drying process has not been adapted to the drying of high-quality lumber from green to the stress-free condition at the low moisture content required for furniture.

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